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Method and apparatus for determining the optimal write power, and optical  
recording medium for use by such method and apparatus

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**Method and apparatus for determining the optimal write power, and optical recording medium for use by such method and apparatus**

The invention relates to a method for setting an optimal value of a write power level of a radiation beam for use in an optical recording apparatus for writing information on an optical recording medium, the information being written on the optical recording medium by applying the radiation beam to the optical recording medium, the method comprising a  
5 first step of writing a series of test patterns in a test area on the optical recording medium, each test pattern written with a different value of the write power level of the radiation beam, a second step of reading the written test patterns to form corresponding read signal portions, and a third step of selecting the optimal value of the write power level in dependence on the read signal portions.

10 The invention further relates to an optical recording apparatus using the method according to the invention, and to an optical recording medium for use by the method and the apparatus according to the invention.

15 In optical recording a method according to the first paragraph is generally referred to as an Optimum Power Control (OPC) procedure. Such an OPC-procedure and a recording apparatus using this procedure are, for example, known from the European patent no. EP 0737962.

20 In optical recording the write power level in practical recording apparatuses is normally set using such an OPC-procedure. This procedure is performed by writing a series of test patterns in a test area on the optical recording medium. This test area, commonly referred to as OPC-area, is generally located at the inner diameter of a disc shaped recording medium. In the OPC-procedure test pattern are written with various values of the write power level of the radiation beam. Subsequently, the written test patterns are read back and  
25 corresponding read signal portions are formed. By measuring for example the modulation and/or the asymmetry of the signal portions, each related to a different value of the write power level of the radiation beam, a value for the optimum write power level can be derived. OPC-procedures for various types of optical media are well known, examples of which can

be found in the various standards for each of these types of media (such as for example: DVD+R 4.7Gbytes Basic Format Specification; Format Description).

It is however a problem that at higher rotational speeds, the OPC-procedure cannot be performed at the inner diameter of a disc anymore. It is generally believed that 160 Hz is about the maximum rotational speed of a disc shaped recording medium for reliable optical recording. In case of DVD recording, this roughly corresponds with a 6x recording speed. So, at recording velocities above 6x the OPC-area at the inner diameter of a disc cannot be used anymore.

In some systems an OPC-area at the outer diameter is defined. However, due to for example homogeneity variations, often the OPC results at the outer diameter are less reliable. Furthermore, the outer part of the disc is more often contaminated with fingerprints. Therefore, many drive designers prefer an OPC-area at the inner diameter. A correct value of the optimum write power level is important for the recording quality, especially at higher recording speeds where the acceptable power margins are in general smaller than at lower speeds.

It is an object of the present invention to provide a method and an apparatus which perform an OPC-procedure at the inner diameter of a record medium that results in reliable write power levels at higher recording speeds.

This object is achieved according to the present invention by providing a method according to the preamble, which is characterised in that in the first step the series of test patterns are written at a low recording speed, and that in the third step the optimal value of the write power level at a high recording speed is selected in dependence on the read signal portions and on a parameter indicative of the relation between the value of the write power level at the high recording speed and the value of the write power level at the low recording speed. In this way, recordings of test patterns at the inner diameter of a disc are still performed at acceptable recording speeds, while the optimal value of the write power level at higher recording speed, at which speeds the recording of test patterns at the inner diameter of a disc is not longer reliable, can still be reliably determined.

In an embodiment it is proposed to define a parameter  $P_{\text{high}}/P_{\text{low}}$ , where  $P_{\text{high}}$  is the optimum write power level at a high recording speed and  $P_{\text{low}}$  is the optimum write power level at the OPC velocity. In this way a drive can determine the optimum write power at the

high recording speed by performing an OPC procedure at a relatively low speed at the inner diameter and by subsequently multiplying the result obtained at this low speed with the parameter  $P_{\text{high}}/P_{\text{low}}$ .

5 It is noted that in principle the indicative power values ( $P_{\text{ind}}$ ) for the high and low velocity of the disc, as currently stored on many optical recording media, can alternatively be used. However, these values are meant to give an indication of the write power values, and the accuracy of these values is not very large. Moreover, the  $P_{\text{ind}}$  value for low velocity is given for the inner diameter OPC area, and the  $P_{\text{ind}}$  value for the high velocity is given for an outer diameter OPC area. So, again homogeneity variations in the medium  
10 may make a ratio based on the  $P_{\text{ind}}$  values less reliable.

In a further embodiment the parameter  $P_{\text{high}}/P_{\text{low}}$  is read from the recording medium itself. The parameter  $P_{\text{high}}/P_{\text{low}}$  may be stored on the recording medium in an area comprising recording parameters indicative of the recording process (including the OPC-procedure), such as for example the ADIP.

15 The value for the parameter  $P_{\text{high}}/P_{\text{low}}$  as stored in the disc can be obtained very accurately during disc development or format verification, using both velocities on one position of the disc. Furthermore, by a well-defined description of this parameter  $P_{\text{high}}/P_{\text{low}}$ , the rounding off errors can be made very small, in any case considerably smaller than when using the indicative power values ( $P_{\text{ind}}$ ).

20 For example:

$N=200(P_{\text{high}}/P_{\text{low}}-1)$ , where  $N$  is a digital value stored in the disc which is related to the parameter  $P_{\text{high}}/P_{\text{low}}$  would result in an accuracy of 0.5%.

## CLAIMS:

1. A method for setting an optimal value of a write power level of a radiation beam for use in an optical recording apparatus for writing information on an optical recording medium, the information being written on the optical recording medium by applying the radiation beam to the optical recording medium, the method comprising a first step of writing  
5 a series of test patterns in a test area on the optical recording medium, each test pattern written with a different value of the write power level of the radiation beam, a second step of reading the written test patterns to form corresponding read signal portions, and a third step of selecting the optimal value of the write power level in dependence on the read signal portions, characterised in that

10 in the first step the series of test patterns are written at a low recording speed, and that in the third step the optimal value of the write power level at a high recording speed is selected in dependence on the read signal portions and on a parameter indicative of the relation between the value of the write power level at the high recording speed and the value of the write power level at the low recording speed.

15 2. Method according to claim 1, wherein the parameter indicative of the relation between the value of the write power level at the high recording speed and the value of the write power level at the low recording speed is read from the recording medium.

20 3. An optical recording apparatus for recording information on an optical recording medium comprising a radiation source for emitting a radiation beam for recording information on the recording medium, the radiation beam having a controllable value of a write power level, a control unit operative for recording a series of test patterns in a test area in the recording medium, each pattern with a different value of the write power level, a read  
25 unit for reading the recorded test patterns and for forming corresponding read signal portions, and setting means for setting an optimal value of the write power level in dependence on the read signal portions, characterised in that the control unit is operative for recording the series of test patterns in the test area in the recording medium at a low recording speed,

and in that the setting means are operative for setting an optimal value of the write power level at a high recording speed in dependence on the read signal portions and on a parameter indicative of the relation between the value of the write power level at the high recording speed and the value of the write power level at the low recording speed.

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4. Apparatus according to claim 3, wherein the read unit is operative for reading the parameter indicative of the relation between the value of the write power level at the high recording speed and the value of the write power level at the low recording speed from the recording medium.

10

5. Optical recording medium comprising an area comprising recording parameters indicative of the recording process, said area comprising a parameter indicative of the relation between the value of the write power level at the high recording speed and the value of the write power level at the low recording speed.

15

6. Optical recording medium according to claim 5, wherein the parameter is related to  $P_{\text{high}}/P_{\text{low}}$ , where  $P_{\text{high}}$  is the optimum write power level at a high recording speed and  $P_{\text{low}}$  is the optimum write power level at the OPC velocity.

**ABSTRACT:**

A method and an optical recording apparatus for determining the optimal write power level at a high recording speed by an OPC-procedure are described. The method involves performing an OPC-procedure at a lower recording speed and subsequently scaling the obtained results to a higher recording speed.

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No Figs.



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